

CLAIMS:

1. A fuel cell system which includes a fuel cell; a supply passage that supplies hydrogen gas to the fuel cell; a discharge passage that discharges the hydrogen gas from the fuel cell; at least one valve element which is located in a predetermined portion in at least one of the supply passage and the discharge passage, and which closes off a hydrogen passage in the fuel cell; and control means for performing control that closes the at least one valve element, comprising:
 - pressure detection means for detecting pressure in the hydrogen passage; and
 - leak determination means for performing analysis of a change in the pressure detected by the pressure detection means when the at least one valve element is closed by the control means, and determining whether there is leak of the hydrogen gas based on a result of the analysis.
2. The fuel cell system according to claim 1, wherein
15 the at least one valve element includes a first valve element located in the supply passage and a second valve element located in the discharge passage.
3. The fuel cell system according to claim 1 or 2, wherein
20 the leak determination means determines whether there is leak of the hydrogen gas when the fuel cell is stopped.
4. The fuel cell system according to any one of claims 1 to 3, wherein the leak determination means includes calculation means for obtaining pressure change speeds when the pressure detected by the pressure detection means reaches two different predetermined levels; and first comparative determination means for comparing both the pressure change speeds obtained by the calculation means, and determining that there is the leak when a difference between both the pressure change speeds exceeds a predetermined value.
- 30 5. The fuel cell system according to claim 4, wherein each of the two different levels is set to a value that can be reached during a period since the at least one valve element is closed until the pressure detected by the pressure detection means, which has decreased, starts to increase.

6. The fuel cell system according to claim 5, wherein one of the two different levels of the pressure is set to a first pressure range in the vicinity of atmospheric pressure, and the other is set to a second pressure range which is on a high pressure side of the first pressure range.

5 7. The fuel cell system according to any one of claims 4 to 6, further comprising pressure reducing means for forcibly reducing the pressure in the hydrogen passage at a certain time between two time points at each of which the pressure change speed is obtained.

10 8. The fuel cell system according to claim 7, wherein the pressure reducing means includes discharge control means for opening the second valve element at the certain time between the two time points.

15 9. The fuel cell system according to claim 7, wherein the pressure reducing means includes electric power control means for causing the fuel cell to generate electric power so that the fuel cell consumes the hydrogen gas in the hydrogen passage at the certain time between the two time points.

20 10. The fuel cell system according to any one of claims 5 to 9, wherein the fuel cell system is installed in a moving object that includes a secondary battery in addition to the fuel cell as a driving source, and the fuel cell system further includes means for obtaining, in advance, a pressure change speed when the pressure is in the second pressure range while operation of the fuel cell is stopped and the moving object is operated using only the secondary battery.

25 11. The fuel cell system according to claim 4, wherein the fuel cell system further includes pressure applying means for applying pressure to the hydrogen passage in the fuel cell, and one of the two different levels of the pressure is set to a first pressure value that can be reached when the pressure applying means applies pressure to the hydrogen passage, and the other is set to a second pressure value that can be reached when the pressure applying means applies pressure to the hydrogen passage again.

30 12. The fuel cell system according to any one of claims 1 to 3, wherein the leak determination means includes minimum pressure value detection means for detecting a minimum pressure value when the pressure detected by the pressure detection means is

lowest; and second comparative determination means for comparing the detected minimum pressure value and a predetermined value, and determining that there is the leak when it is determined that the minimum pressure value is higher than the predetermined value.

5 13. The fuel cell system according to claim 12, further comprising pressure reducing means for forcibly reducing the pressure in the hydrogen passage at a certain time during a period since the at least one valve element is closed by the control means until the minimum pressure value is detected by the minimum pressure value detection means.

10 14. The fuel cell system according to claim 13, wherein the pressure reducing means includes discharge control means for opening the second valve element at the certain time during the period since the at least one valve element is closed by the control means until the minimum pressure value is detected by the minimum pressure value detection means.

15 15. The fuel cell system according to claim 13, wherein the pressure reducing means includes electric power control means for causing the fuel cell to generate electric power so that the hydrogen gas in the hydrogen passage is consumed at the certain time during the period since the at least one valve element is closed by the control means until the minimum pressure value is detected by the minimum pressure value detection means.

20 16. A gas leak detection method for detecting hydrogen gas leak in a fuel cell system which includes a fuel cell; a supply passage that supplies hydrogen gas to the fuel cell; a discharge passage that discharges the hydrogen gas from the fuel cell; and at least one valve element which is located in a predetermined portion in at least one of the supply passage and the discharge passage, and which closes off a hydrogen passage in the fuel cell, comprising the steps of:

25 (a) closing the at least one valve element;

(b) detecting pressure in the hydrogen passage in the fuel cell; and

(c) performing analysis of a change in the pressure detected in the step (b) when the at

30 least one valve element is closed in the step (a), and determining whether there is leak of the hydrogen gas based on a result of the analysis.

17. The gas leak detection method according to claim 16, wherein the step (c) includes the steps of (c-1) obtaining pressure change speeds when the pressure detected in the step

(b) reaches two different predetermined levels; and (c-2) comparing both the pressure change speeds obtained in the step (c-1), and determining that there is the leak when a difference between both the pressure change speeds exceeds a predetermined value.

5 18. The gas leak detection method according to claim 17, wherein one of the two different levels of the pressure is set to a first pressure range in the vicinity of atmospheric pressure, and the other is set to a second pressure range which is on a high pressure side of the first pressure range.

10 19. The gas leak detection method according to claim 16, wherein the step (c) includes the steps of (c-1) detecting a minimum pressure value when the pressure detected in the step (b) is lowest; and (c-2) comparing the detected minimum pressure value and a predetermined value, and determining that there is the leak when it is determined that the minimum pressure value is higher than the predetermined value.

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20. A fuel cell system comprising:

a fuel cell;

a supply passage that supplies hydrogen gas to the fuel cell;

a discharge passage that discharges the hydrogen gas from the fuel cell;

20 at least one valve element which is located in a predetermined portion in at least one of the supply passage and the discharge passage, and which closes off a hydrogen passage in the fuel cell;

a controller that performs control of closing the at least one valve element;

a pressure detector that detects pressure in the hydrogen passage; and

25 a leak determination device that performs analysis of a change in the pressure detected by the pressure detector when the at least one valve element is closed by the controller, and determines whether there is leak of hydrogen based on a result of the analysis.